ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

Report On

PROJECT NO. 12 - TEST OF ACCOUSTI-GUARD (EAR PROTECTIVE DEVICE)

Project No. 12

INFORMATION COPY

5 November 1943

ARMORED MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

Project No. 12
741.7 GNOML

5 November 1943

1. PROJECT: No. 12, Test of Acousti-guard (Ear Protective Device).

a. Authority - Letter, Commanding General, Army Ground Forces, Washington, D. C., and 1st Indorsement, Commanding General, Headquarters Armored Force, Fort Knox, Kentucky, 413.44-112/(4-27-43) GNOHD, dated May 1, 1943. See Appendix A.

b. Purpose - To determine the degree of protection provided by the Acousti-guard Ear Protective Device against injurious high-level sound intensities, such as from gun blast.

2. DISCUSSION:

a. The primary purpose of any ear protective device is to provide adequate insulation against high-level sound intensities so that the magnitude of the sound reaching the ear drums is reduced to non-injurious levels. Industrial experience with men subjected to prolonged noise of great intensity indicates that a permanent hearing loss may be suffered, particularly in the higher frequency range.

b. Instantaneous sound levels in excess of 140 db have been observed during the firing of 75 mm tank guns. Tank and artillery personnel are therefore subjected to such levels many hours daily during their regular training periods. This indicates a need for an effective ear-protective device for army personnel who are thus exposed.

c. Protection is now commonly obtained with cotton rolled into a ball or cylinder and inserted in the ear canal. This provides some protection at higher sound levels but it also reduces sound at conversational levels, making the wearer unable to hear commands. A plug of this type also will become dirty, increasing the possibility of infection in the ear canal, and makes no provision for equalizing atmospheric pressure on the two sides of the plug.

d. The subject "Acousti-guard" ear protector, which is fabricated of a plastic, consists of a hollow disc 1-5/8" diameter x 1/4" thick containing within a plastic diaphragm. The sound enters through a small hole in the outer surface of the disc, passes around the diaphragm, and out through a cylindrical hole which continues through a fitting shaped to fit into the outer ear. A cloth pad 2-1/4" diameter is attached around the cylinder on the inner surface of the disc. This is provided to keep the device tight over the ear opening and thus minimize noise leakage.

e. The device is designed to provide protection at higher sound levels by the action of the diaphragm which is forced against the discharge port by the pressure of the sound wave. At lower sound levels the pressure exerted is said to be insufficient to close the diaphragm, thus permitting sound to pass through the device without serious diminution.

f. Both laboratory and field tests have been conducted with this device. The former tests consisted in systematic measurement of the insulation provided over a wide range of sound levels. In the field tests the practical application of the device was observed and its effectiveness against the high-level sound intensities (instantaneous maximum above 140 db) encountered in gun fire was studied.

3. CONCLUSIONS:

a. Specific protection afforded by the claimed valve-like action was not apparent in the laboratory or field tests. The effectiveness of any device of this type is contingent upon the securing of a good acoustic seal. This has not been achieved; consequently any benefits which the diaphragm may possess are lost.

b. The principle of protection by diaphragm action appears sound. Further development of a device to provide positive valve action and insure a good acoustic seal may demonstrate its qualities.

c. The "Acousti-guard" when tightly fitted against a sound source cavity reduced harmful levels of sound at low frequencies (100-1000 cps), this reduction being of the order of 40 db at exposure levels of 130 db. The effect was largely independent of the presence of the diaphragm which added only 5 db to the total insulation.

d. The device at present is not rugged enough to withstand the wear and tear of field use. The plastic case joints break apart easily and the stem fractures on dropping.

e. The device cannot be worn comfortably with a tank crash helmet and the steel helmet liner knocks the device from the ear upon touching.

4. RECOMMENDATION:

Although the principle of the diaphragm valve-like action appears sound, the "Acousti-guard" in its present form fails to demonstrate this quality and therefore has no application.

Prepared by:
R. H. Walpole, Jr., Capt., Sn C

APPROVED Willard Machle
WILLARD MACHLE
Colonel, Medical Corps
Commanding

2 Incls:
#1 - Appendix A & B
#2 - Table 1

APPENDIX A

Headquarters
ARMY GROUND FORCES
Army War College
Washington, D.C.

Apr 27 1943

426/205-GNRQT-10/39090
(4-27-43)

SUBJECT: Acousti-guard.

TO : Armored Force Medical Research Laboratory, Fort Knox, Ky.

1. On or about July 1, 1943, there will be sent to you for test twenty-five (25) Acousti-guard, ear protective devices, manufactured by the Radio and Television, Inc., 224 Madison Avenue, New York City.

2. It is requested that this Headquarters be advised upon receipt of this material and appropriate directive for test will be furnished.

By command of Lieutenant General LEAR:

/s/ R. J. Delacroix
R. J. DELACROIX
Captain, A.G.D.
Asst. Ground Adj. Gen.

413.44-112 (4-27-43) GNOHD 1st Ind.

HEADQUARTERS ARMORED FORCE, Fort Knox, Kentucky, May 1, 1943.

TO: Commanding Officer, Armored Force Medical Research Laboratory, Fort Knox, Kentucky.

For compliance as requested in paragraph 2, basic communication.

By command of Lieutenant General DEVERS:

/s/ E. R. Gray, Jr.
E. R. GRAY, JR.
Major, A. G. D.
Asst. Adjutant General

APPENDIX B

Methods of testing and measuring the insulative qualities of the Acousti-guard were as follows:

A sealed box containing a variable sound source (a 12-volt siren) was buried in the ground 18 inches below grade level. A 1-1/2" diameter steel pipe was extended from directly over the siren within the box to a height of approximately 12" above grade. Sound levels, measured by a General Radio Sound Level Meter, Model 759B, at the end of the pipe ranged from 131 db to 86 db with the pipe end open. With the end closed, by means of a rubber stopper, corresponding levels were 81 db to 41 db. Frequencies ranged from a maximum of 1000 cps at the high sound level, to a minimum of 128 - 256 cps at the lower intensity level. Using these two extremes of sound level as a basis of comparison, insulating value of the Acousti-guard was measured with the device held tightly in place over the pipe end. The microphone remained in the same position during all the tests. Tests were conducted on four (4) different models of the Acousti-guard devices, and one with the diaphragm removed in order to measure the effectiveness of the valve-action. Results are shown on Table 1.

Field tests were conducted on personnel subjected to considerable gun blast from 75 mm guns. Prior to exposure audiogram curves were obtained on the test subjects and the Acousti-guard sets properly fitted. After 3 hours of exposure to gun-fire blast, the subjects requested permission to remove the Acousti-guards and replace them with cotton plugs since the device was providing no noticeable protection. Post exposure audiograms were not conducted as the firing schedule prohibited the subject personnel from leaving their post. None of the personnel were able to keep the Acousti-guard in place, helmet edges knocking the device from the ear. It was found that crash helmets exerted pressure upon the device which became intolerable after short periods.

SOUND INSULATING VALUE OF ACOUSTI-GUARD

Exposure Level Decibels	Frequency c/s	Reduction thru Acousti-guard Decibels	
		Without Diaphragm	With Diaphragm
127	500-1000	44	49
120	500-1000	37	41
119	500-1000	41	43
117	± 500	39	44.5
103.5	350	31.5	41.5
74.5	128-256	24.5	30

Average reduction attributable to presence of diaphragm - 5.7 db

TABLE 1

Insul #2